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Continuous Commissioning of DDC Systems – Owner's Perspective

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Presentation Outline

- Importance of DDC Systems to Continuous Commissioning and Good Building Operation
- Problems Encountered
  - Calibration
  - Configuration
  - Programming
  - Design/Installation
- Need for Operator Training
- Possible Solutions

Continuous Commissioning®[1]

Continuous Commissioning is the process of saving energy and improving occupant comfort through optimization of building/plant HVAC and DDC systems.

[1] Continuous Commissioning and CC are registered trademarks of the Texas Engineering Experiment Station (TEES), the Texas A&M University System, College Station, Texas.

Steps in CC Process

- Sensor verification/calibration
- Determination of schedules for HVAC equipment
- Occupancy schedules
- Measurement of air flows, pressures, performance
- Optimization of schedules, equipment, air flows
- Operator training
- Continuous follow-up

Typical Continuous Commissioning Results

- ❖Improved comfort
- ❖Reduced maintenance costs
- ❖15-25% annual energy savings
- ❖One to three year simple paybacks

DDC Continuous Commissioning Problems - Selected Examples

- Sensor Calibration Issues
- Point Configuration Errors
- Programming Problems
- Design/Installation Issues

Sensor Calibration Issues

Chilled water flow meter calibration

- design engineer called for 300 gpm minimum flow
- flow meter was out of calibration – actual flow was 800 gpm

Results (from one failed sensor!)

- VFD pump speed was 80% summer and winter
- High DP caused leakage of CW valves
- Excessive use of reheat summer and winter

Space Temperature Sensor Out of Calibration

Auditorium served by two single zone AHU’s, each with its own temperature sensor.

With an error in temperature sensors
- One AHU was cooling
- Second unit was heating

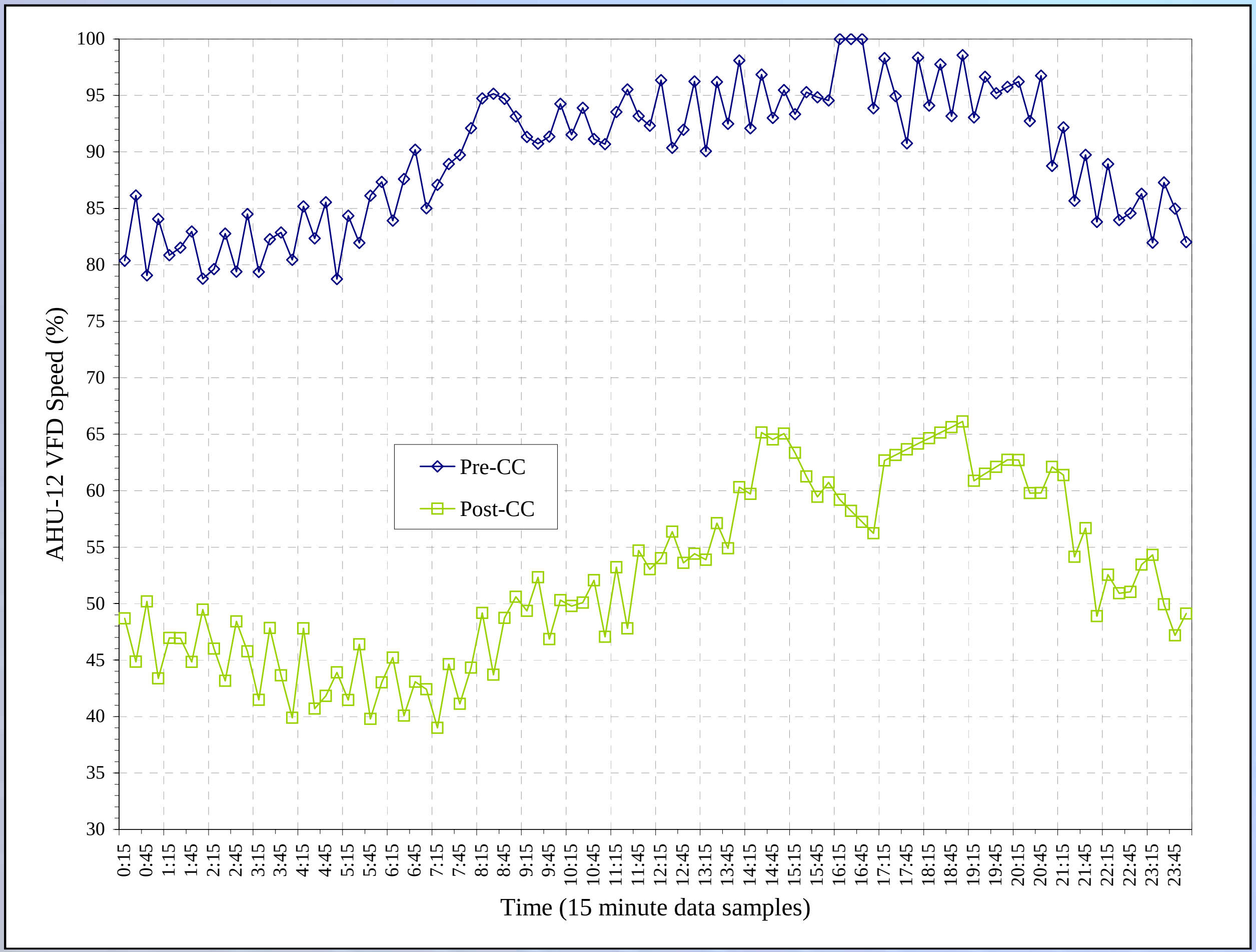
- Failed CO_2 sensor in a building with CO_2 control sensor was reading 2000 ppm, which drove the OA damper to 100% open

VAV Box Flow Sensor Calibration

- In a relatively new building (4 years old and with a modern DDC system), 70% of VAV boxes were miscalibrated on flow and required recalibration
- In a large medical research building many VAV boxes were out of calibration, resulting in too high an air flow and unnecessary reheat

Point Configuration Errors

Static Pressure Sensor Configuration



Air Flow Meter Configurations

- In two buildings in different states, air flow measurements were calculated as a linear rather than square root function of velocity pressure
- Duct static pressure was used instead of velocity pressure for air flow calculations
- Velocity pressures used directly for flow tracking—DDC system subtracted return fan and general exhaust velocity pressure from supply fan velocity pressure

Fan Status Configuration

- CW pump operation was linked to off/on of AHU's, but no "proof" point for AHU status was installed. Even though AHU's were off, CW pump continued to run 24 hrs/day
- AHU CW valves were 100% open to try to maintain air flow temperature set point (with no air!), so CW flow was much higher at night than in daytime

Programming Errors

- Direct Acting vs. Reverse Acting
- Direct Acting PID action increases the control output when process variable is above the set point
- Reverse Acting PID action decreases the control output when the process variable is above the set point

Direct Acting Vs. Reverse Acting

Examples

- Return fan was supposed to track supply fan cfm, speeding up when supply cfm increased and slowing down when cfm decreased, but it was configured as reverse acting—ran nearly 100% speed for more than four years before CC
- Preheat valve for kitchen make-up air was programmed backwards. As the make-up air got hotter the HW valve was commanded to open wider

Incorrect Set Points and Inputs

- Preheat set point of 53°F for outside air AHU, defeated use of economizer, wasting both cooling and heating energy
- Unoccupied temperature set-up of 78°F caused increased reheating of large arena during summer

De-Icing System Set Point

De-icing system was programmed to activate for outside air conditions as follows:

OAT below 38°F <u>OR</u> relative humidity above 78%

(Should have been <u>AND</u>)

Design/Installation Problems

- Inoperable air-to-air heat exchanger dampers
- CO_2 sensor installed in mixed air chamber
- Chilled water DP sensor was a supply side pressure sensor
- Cold deck temperature sensor placed after heating coil instead of after cooling coil and before heating coil

Operator Training Issues

Most operators of facilities we have worked with do not have adequate training on DDC systems. They can typically change set points, make schedule changes, and turn systems on/off. They typically do not make programming changes, understand calibration procedures, or have the tools for many basic measurements.

Possible Solutions/Recommendations

1. Make commissioning "business as usual" and bring commissioning authority in during design phase
2. Start Continuous Commissioning process 3 to 4 months prior to the end of the HVAC/DDC warranty period by a thorough calibration/system verification, thus identifying failed components while in warranty
3. After vendors have replaced failed parts, begin CC optimization process for energy savings and comfort improvements

Possible Solutions/Recommendations (cont'd)

4. Train operators, first on system operations, and later, on the CC optimization
5. Give them the tools they need for measurement and calibration
6. Help them understand implications of energy efficiency
7. Keep commissioning "continuous."